ANASIEZE IKENNA – CLOUD & AI ENGINEER

Project: Cloud SQL Data Pipeline & Analytics Project

Overview

This guide provides a comprehensive walkthrough of a cloud-native data engineering project built on Google Cloud Platform (GCP).
For technical teams: Detailed commands, code snippets, and architectural diagrams.
For non-technical teams: Business context, impact analysis, and visual workflows.

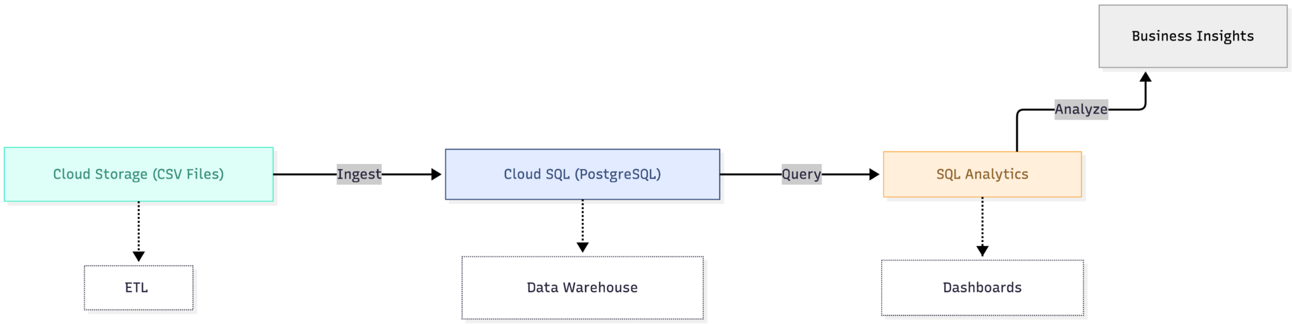
Business Problem

Airlines and transportation agencies need to analyze flight performance, delays, and operational efficiency across 300,000+ flight records to optimize routes, reduce costs, and improve passenger experience.

Technical Solution

A scalable ETL pipeline that:
1. Extracts flight data from public sources.
2. Transforms and loads it into Cloud SQL (PostgreSQL).
3. Analyses data using SQL to generate actionable insights.

Architecture Diagram



Step-by-Step Setup

⇒ Prerequisites

- Google Cloud Platform account
- Basic knowledge of SQL and command line
- Access to Cloud Shell

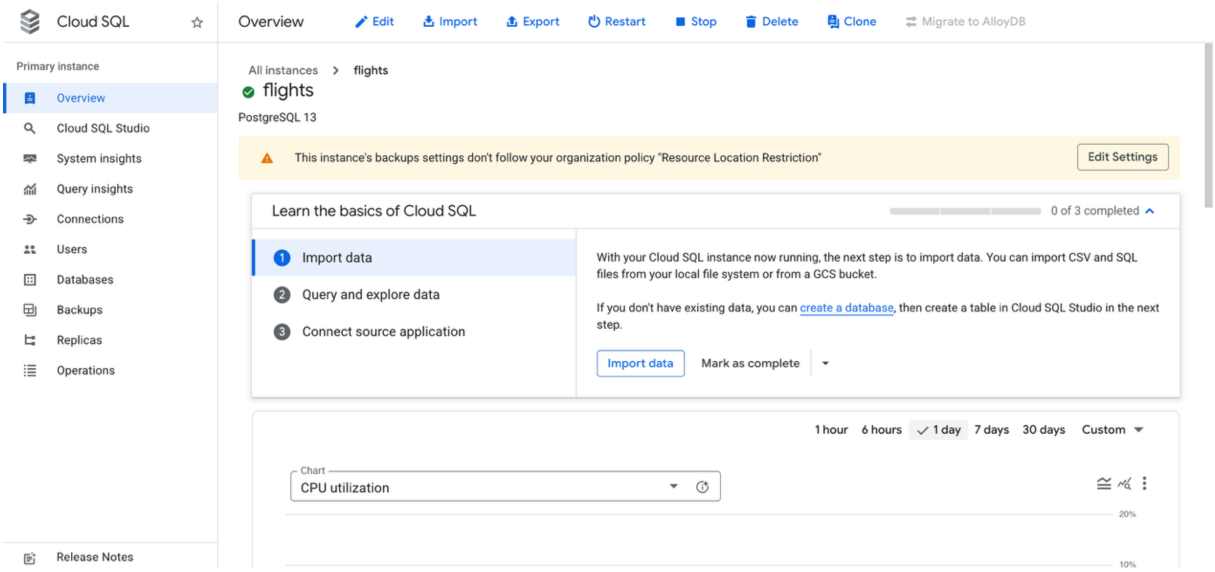
⇒ Environment Setup

Step 1: Launch Cloud Shell
1. Log into [Google Cloud Console](https://console.cloud.google.com).

2. Click the Cloud Shell icon.

Step 2: Create Cloud SQL Instance

```bash
gcloud sql instances create flights \
 --database-version=POSTGRES_13 \
 --cpu=2 \
 --memory=8GiB \
 --region=us-central1 \
 --root-password="Your secure password"
```



This instance's backups settings don't follow your organization policy "Resource Location Restriction"

With your Cloud SQL instance now running, the next step is to import data. You can import CSV and SQL files from your local file system or from a GCS bucket.

If you don't have existing data, you can create a database, then create a table in Cloud SQL Studio in the next step.

Non-Technical Explanation:
This command provisions a managed PostgreSQL database with 2 CPUs and 8GB RAM, located in Iowa (us-central1). It's like renting a secure, scalable database server in the cloud.

Step 3: Prepare Cloud Storage

```bash
 Create a unique bucket for data files
export PROJECT_ID=$(gcloud info --format='value(config.project)')
export BUCKET=${PROJECT_ID}-flight-data
```

Non-Technical Explanation:
Creates a cloud storage folder (bucket) to hold raw flight data files.

⇒ **ETL Pipeline Development**

Data Extraction
For Technical Teams

```bash
Download flight data
wget https://sampleflightdata/nycflights13.csv

Upload to Cloud Storage
gsutil cp nycflights13.csv gs://$BUCKET
```

For Non-Technical Teams
- Data is sourced from the US Bureau of Transportation Statistics.
- Files are automatically transferred to secure cloud storage.

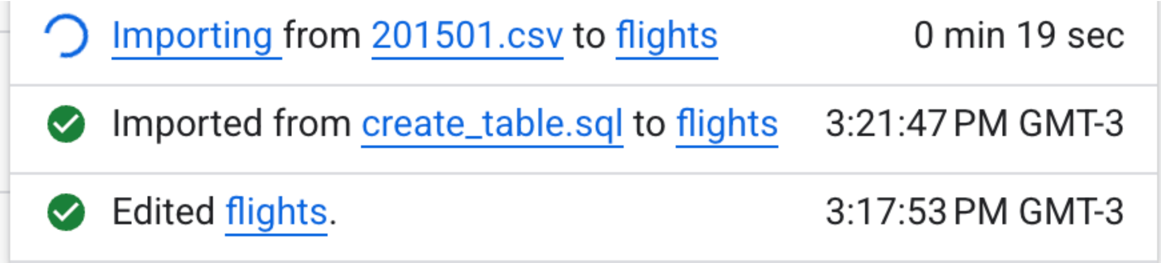
⇒ **Data Loading into Database**

Step 1: Create Table Schema
Technical Code:

```sql
-- create_table.sql
CREATE TABLE flights (
  "Year" TEXT,
  "Quarter" TEXT,
  "Month" TEXT,
);
```

Step 2: Import Data

```bash
 Import CSV into PostgreSQL
gcloud sql import csv flights \
 gs://$BUCKET/nycflights13.csv \
 --database=postgres \
 --table=flights
```



Importing from 201501.csv to flights 0 min 19 sec

Imported from create_table.sql to flights 3:21:47 PM GMT-3

Edited flights. 3:17:53 PM GMT-3

Non-Technical Explanation:
This step loads the flight records into the database table, similar to importing a spreadsheet into a more powerful analysis tool.

⇒ **Database Analytics**

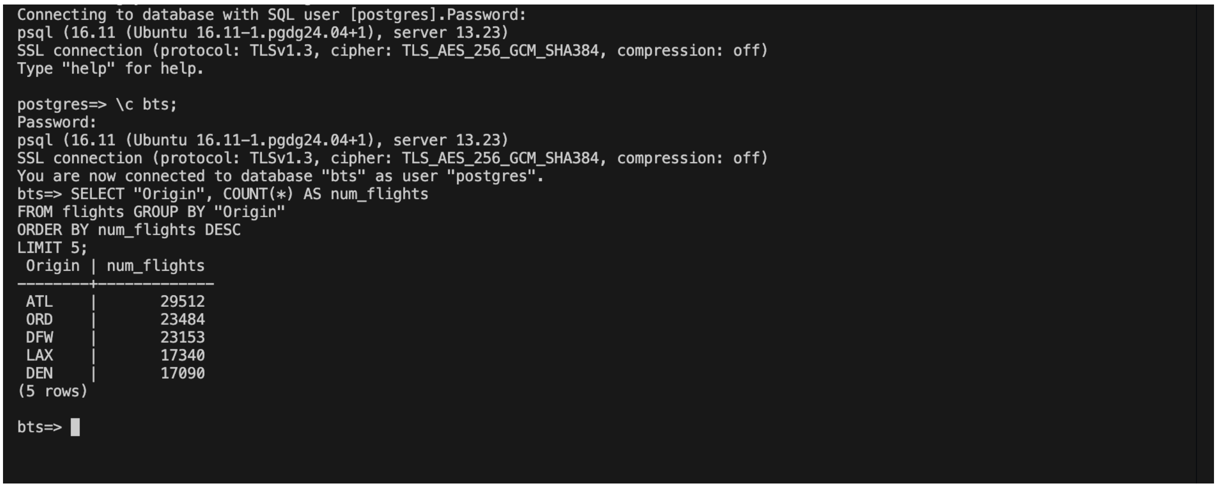
Key Business Queries

Query 1: Top 3 Busiest Airports

```sql
SELECT "Origin",  COUNT() AS num_flights
FROM flights
GROUP BY "Origin"
ORDER BY num_flights DESC
LIMIT 3;
```

Output:

Origin	**Num_flights**
ATL	29,512
ORD	23,484
DFW	23,153



```
Connecting to database with SQL user [postgres].Password:
psql (16.11 (Ubuntu 16.11-1.pgdg24.04+1), server 13.23)
SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, compression: off)
Type "help" for help.

postgres=> \c bts;
Password:
psql (16.11 (Ubuntu 16.11-1.pgdg24.04+1), server 13.23)
SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, compression: off)
You are now connected to database "bts" as user "postgres".
bts=> SELECT "Origin", COUNT(*) AS num_flights
FROM flights GROUP BY "Origin"
ORDER BY num_flights DESC
LIMIT 5;
 Origin | num_flights
--------+-------------
 ATL    |       29512
 ORD    |       23484
 DFW    |       23153
 LAX    |       17340
 DEN    |       17090
(5 rows)

bts=> 
```

Query 2: Average Delay by Airline

```sql
SELECT "Reporting_Airline",
      AVG("DepDelayMinutes") AS avg_delay
FROM flights
GROUP BY "Reporting_Airline"
ORDER BY avg_delay DESC;
```

Business Insight: Identifies airlines with frequent delays for operational reviews.

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